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A62C 3/08

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A5A A20X5

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WO 91/07208 A

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(54) Aircraft fire preventions and extinguishing system

(57) An aircraft passenger cabin is divided into zones (10A to 10E). Within each zone, a manifold (18) is connected to a pressurised water tank (40) via a respective supply pipe (20) and a respective valve (42). The manifold (18) is connected to normally closed spray nozzles (22 to 30) mounted within that zone and each of which can be opened by a control signal on a respective control line (33). Preferably when the temperature in a particular zone reaches a first critical level, a signal from a sensor (48, 46) on a control line (50, 52) causes a control unit (44) to detect the relevant zone and to open the valve (42) connecting the tank (40) with the manifold (18) of that zone (only). The pipe (20) and the manifold (18) of that zone become pressurised with water, although the spray nozzles (22 to 30) remain closed. If the temperature in that zone reaches a second critical level, the control unit (44) signals to that zone to open all the spray nozzles (22 to 30) of that zone and to cause water discharge. All the water is available for use in any one of the zones, and maximum water utilisation efficiency is achieved.

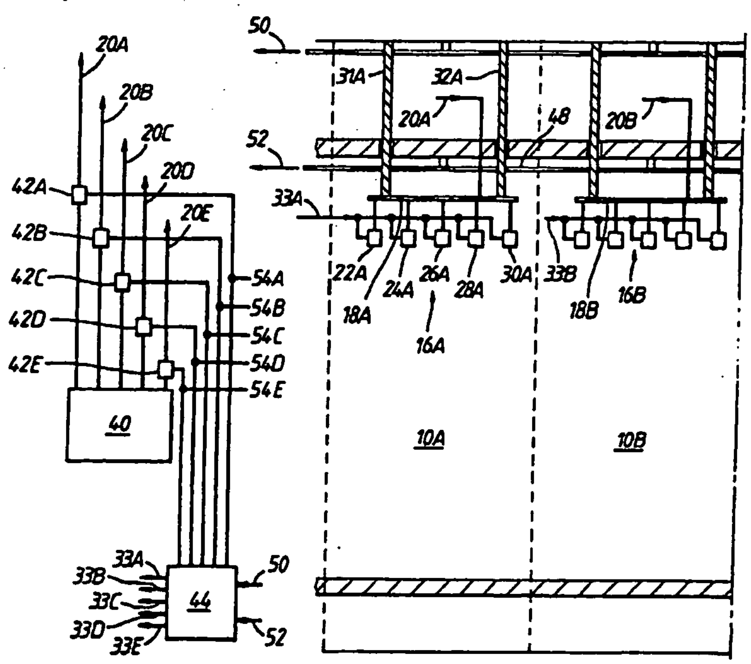

Fig.1.

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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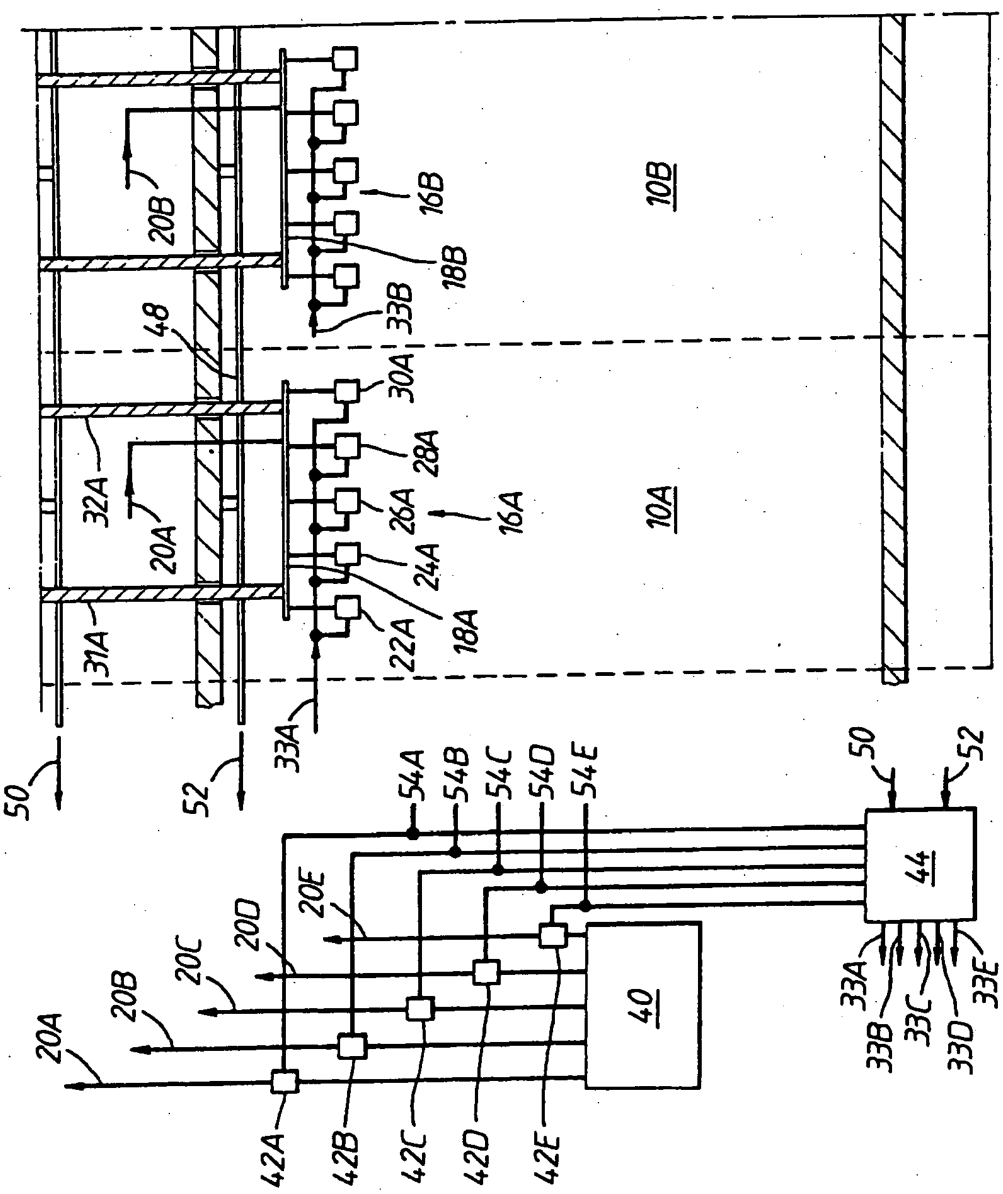
10A
10B
16A
16B
18A
18B
20A
20B
20C
20D
20E
22A
24A
26A
28A
30A
31A
32A
33A
33B
33C
33D
33E
40
42A
42B
42C
42D
42E
44
48
50
52
54A
54B
54C
54D
54E

Fig.1.

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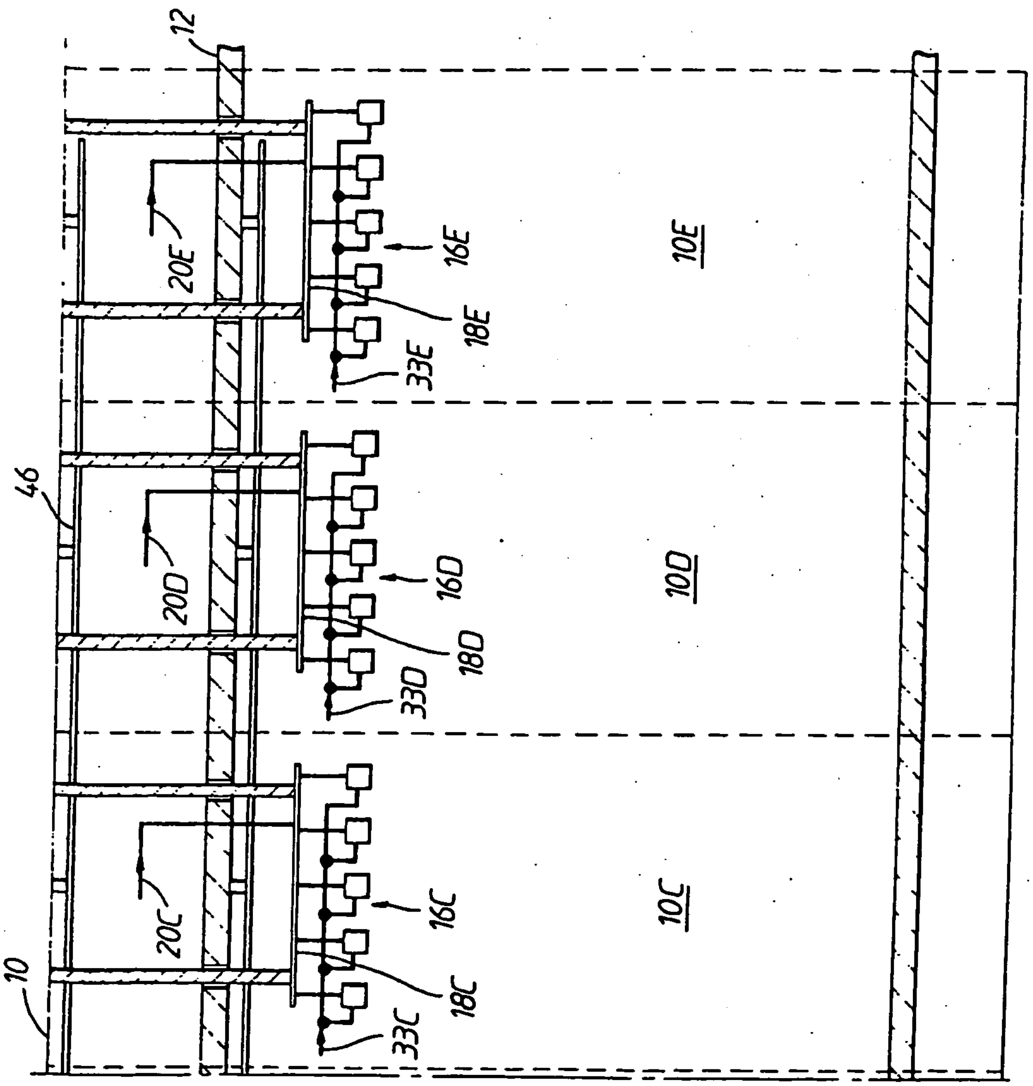
12
46
10
20E
16E
18E
33E
10E
20D
16D
18D
33D
10D
20C
16C
18C
33C
10C

Fig.1. cont.

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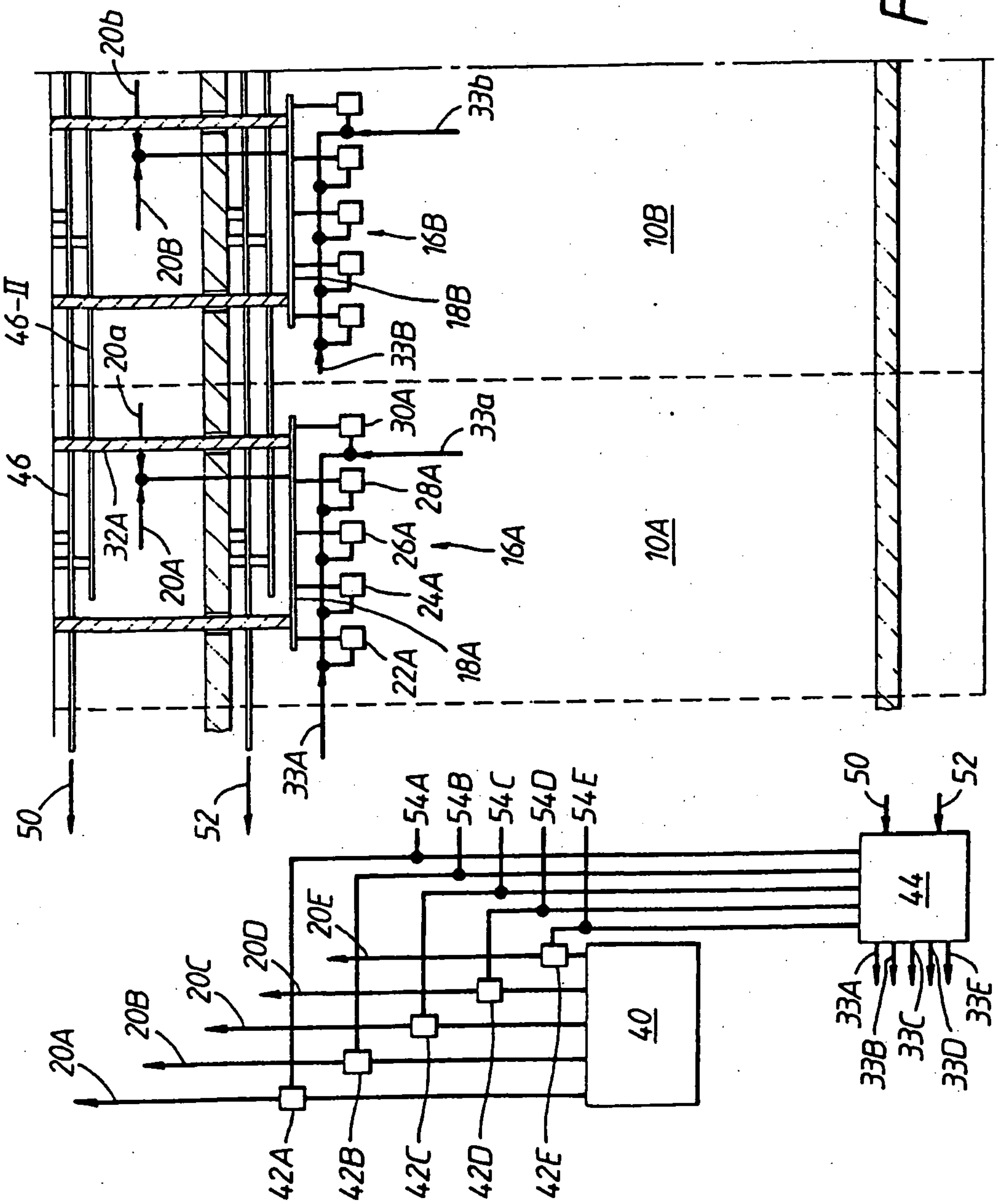
20b
46-II
20a
46
32A
20A
20B
30A
33a
28A
26A
24A
22A
18A
16A
10A
33b
16B
18B
33B
10B
50
52
33A
54A
54B
54C
54D
54E
20E
20D
20C
20B
20A
40
44
42A
42B
42C
42D
42E
33A
33B
33C
33D
33E

Fig.2.

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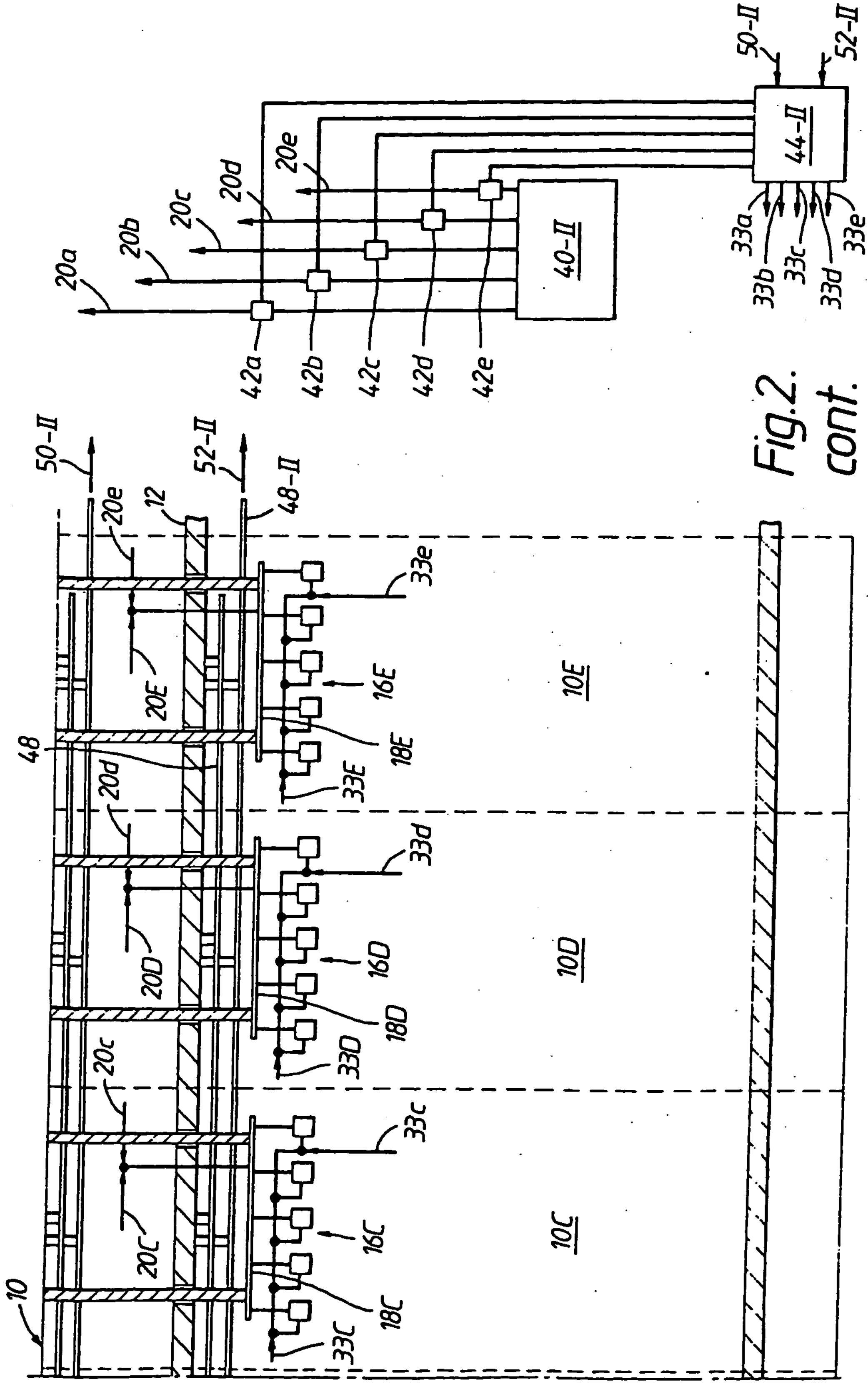
50-II
52-II
44-II
40-II
20a
20b
20c
20d
20e
42a
42b
42c
42d
42e
33a
33b
33c
33d
33e
48-II
12
10
48
20E
20D
20C
16E
16D
16C
18E
18D
18C
33E
33D
33C
10E
10D
10C

Fig.2. cont.

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PROTECTING AGAINST FIRE

The invention relates to protection against fire. Systems embodying the invention and to be described below by way of example only use sprayed water for protecting aircraft passenger cabins against fire.

According to the invention, there is provided a system for preventing or extinguishing fires in the cabin of an aircraft, comprising a plurality of water spray arrangements positioned within respective longitudinally spaced zones of the cabin, a water supply tank for all the water spray arrangements, connection means for separately connecting each water spray arrangement to the tank, a fire sensing arrangement for sensing for fire risk in each zone, and control means responsive to the fire sensing arrangement to cause water from the tank to be discharged by the water spray arrangement of any particular zone when the fire sensing arrangement detects a fire-critical condition therein.

According to the invention, there is also provided a system for preventing or extinguishing fires in aircraft cabins, comprising water spray means mounted within the cabin along its length and controllably openable, at least one water supply tank, pipe means connecting the tank to

the water spray means and normally empty of water, fire sensing means for detecting a fire-critical condition and for causing opening of the water spray means to permit discharge of water therethrough from the water tank, and control means operative in response to detection of a warning condition indicative of an approaching fire-critical condition to prime the pipe means with water from the supply tank prior to occurrence of the fire-critical situation.

According to the invention, there is further provided a system for preventing or extinguishing fires in aircraft cabins, comprising water spray means positioned along the length of the aircraft cabin, at least one water supply tank, connection means controllably connecting the water supply tank to the water spray means, and fire sensing means positioned within the cabin and operative in response to detection of a fire-critical condition to cause water to be supplied to the water spray means from the tank by the connection means and to be discharged into the cabin by the water spray means, the fire sensing means comprising a first fire detector within the cabin and attached to the ceiling of the cabin, and a second fire detector attached essentially directly to the fuselage of the aircraft so as to be substantially unaffected by collapse of the ceiling in the event of an aircraft crash.

Water spray systems embodying the invention and for protecting aircraft passenger cabins against fire will now be described, by way of example only, with reference to the accompanying diagrammatic drawings in which:

Figure 1 is a diagrammatic longitudinal cross-section through part of the passenger cabin of an aircraft showing one of the systems; and

Figure 2 corresponds to Figure 1 and shows another of the systems.

Figure 1 shows part of the aircraft fuselage 10 encompassing the passenger cabin.

The water spray systems to be described in detail below are for protecting the cabin against fire. Although the systems may detect, and then act to extinguish, an actual fire in the cabin, the primary objective is to detect temperature increase inside the cabin caused by an external fire (e.g. in the event of a crash) and to respond to such detection of temperature increase by releasing water spray within the cabin with a view to minimising the risk of combustion of material within the cabin.

Figure 1 shows the ceiling 12 of the passenger cabin and its floor 14. For the purpose of implementing the system to be described, the passenger cabin is divided into notional zones indicated in Figure 1 at 10A,10B,10C,10D and 10E. Each zone encompasses approximately eight rows of seats in this example. However, the zones may be larger or smaller than this and there may of course be more or less than five zones in number. Each zone is provided with a separate water spray arrangement. As shown for zone 10A, the water spray arrangement 16A comprises a manifold 18A which is fed by a water supply pipe 20A. The manifold 18A supplies water spray nozzles 22A,24A,26A,28A and 30A in this example though there may be more or less than five such nozzles. In practice, the manifold 18A may be in three parallel-connected parts, one running centrally along the ceiling in the respective zone and each of the other two running along a respective side of the fuselage in that zone. As illustrated, the manifold 18A is supported by supports 31A and 32A which project through the ceiling 12 from the roof of the fuselage. This ensures that, in the event of a crash or hard landing, resulting in collapse of the ceiling 12, the manifold 18A and the nozzles 22A to 30A are unaffected. Each nozzle 22A to 30A is normally closed but can be opened upon receipt of the control signal on a line 33A.

The water spray arrangements for each of the other zones are of the same form as shown for the water spray arrangement 16A and their component parts are referenced with the same reference numerals but with the addition of the appropriate suffix "B","C" etc; to simplify the drawing, most of these references are omitted.

The water supply pipes 20A,20B,20C,20D and 20E are supplied from a water tank 40 through respective valves 42A,42B,42C,42D and 42E. To simplify the drawing, the complete pipe connections are not shown.

The control lines 33A to 33E are connected to a central control unit 44. Again, to simplify the drawing, the complete connections are not shown.

Temperature detection is carried out by two separate longitudinal temperature sensors 46 and 48. Sensor 46 is rigidly supported from the roof of the fuselage 10, while sensor 48 is rigidly supported from the ceiling 12. Sensor 46 produces a temperature-dependent output signal on a line 50 and sensor 48 produces a temperature-dependent output signal on a line 52. Lines 50 and 52 carrying the temperature-dependent output signals are connected to the control unit 44. Again, though, the actual connections are omitted to simplify the

drawing. As will be explained in more detail below, the control unit 44 is able to determine, from the output signals received from the temperature sensors, not only when an overheat condition occurs but its position along the cabin (that is, the particular zone in which the overheat is present). A suitable sensor is sold by the Applicants under the trade mark FIREWIRE.

Control unit 44 controls the valves 42A to 42E by connections 54A to 54E.

The operation of the system will now be described.

Although the system has (in this example) a single water supply tank 40 and a single control unit 44, each of the five zones in the system operates independently. In a manner to be explained in more detail, in the event of detection of an abnormally high temperature in a particular zone by the sensors, water spray is initiated in that zone, but not in the other zones. Such an arrangement has been found to provide a very large increase in efficiency of water utilisation as compared with systems in which, in the event of high temperature detection, water is sprayed into the whole of the passenger cabin or perhaps into one or two or three relatively large sections of it. Because of weight

restrictions in aircraft, it is clearly possible to carry only a relatively limited supply of water and it is therefore important to maximise the efficiency with which such water is used for fire prevention or extinguishing purposes.

The system described is also advantageous as compared with arrangements in which the aircraft fuselage is divided into sections each of which is provided with a substantially independent water spray system having its own water supply tank. By using only a single tank, the system being described is advantageous in that all the water is available for use by any particular zone.

Considering the operation in more detail, the water within the tank 40 is pressurised by suitable means such as by pressurising gas. Valves 42A to 42E are normally closed. The pipes 20A to 20E are thus normally empty of any water. This minimises the effective weight of the water pipes running along the fuselage, simplifying their construction and reducing their inherent weight, and also simplifying anti-freezing precautions. It also ensures that all the stored water is available for use by any one of the zones. However, the system incorporates means to eliminate or minimise any delay in water discharge which might otherwise be caused by the need to fill the

appropriate pipe 20A to 20E before such discharge could take place. This is achieved by arranging for the control unit 44 to monitor the temperature within each zone 10A to 10E (as measured by the two sensors 46,48) and to detect when (and in which zone) the rising temperature reaches an initial warning level which is below the fire-critical level at which water discharge is to take place. For example, this initial warning level could be 130°C. As soon as that warning level is detected in a particular zone, the control unit 44 reacts to the appropriate signal (as received on line 50 or 52) by opening the appropriate valve 42A to 42E. This is carried out by means of a control signal on the appropriate one of control lines 54A to 54E. During this process, the spray nozzles 22 to 30 in the appropriate zone still remain closed. The opening of the particular valve 42A to 42E thus causes the respective pipe 20A to 20E to become rapidly filled with pressurised water from the tank 40, this water pressurising the appropriate manifold 18 which presents a pressurised water supply at each nozzle of that zone.

If the temperature within that zone continues to rise and reaches the fire-critical level (e.g. 150°C), indicative of a fire condition or an imminent fire condition, this is detected by control unit 44 (by means of an appropriate signal received on line 50 or 52). The control unit

responds by outputting a signal on the appropriate output line 33 for that zone which rapidly opens each of the spray nozzles 22 to 30 of that zone. This produces instant water discharge from the already-pressurised spray nozzles.

If the temperature in any particular zone reaches the first warning level, so as to pressurise the respective initial 20, but does not reach the fire-critical warning level, water spray will not of course take place. When the aircraft lands, action can be taken to pump the water out of the pressurised pipe so as to initialise the system again.

Temperature sensing within each zone is normally carried out by the sensor 48 which is suspended from the cabin ceiling 12. This sensor will provide a better measure of the cabin temperature in that particular zone than the sensor 46, which is above the ceiling. However, in the event of a crash or hard landing which causes the collapse of the ceiling 12, the sensor 48 is likely to be put out of action. Under such circumstances, the sensor 46 is able to continue temperature monitoring because, being attached to the fuselage roof, it will be unaffected by collapse of the ceiling.

The water tank 40 and the control unit 44 may be located at any convenient position along the length of the aircraft. If desired, there may be two control units 44, one located at one end of the aircraft and connected to the temperature sensors 46 and 48 as shown in Figure 1 and the other located at the other end of the aircraft and connected to duplicate temperature sensors respectively running alongside the sensors 46 and 48. In this way, temperature sensing from both ends of the aircaft is possible even in the event of break-up of the fuselage.

Figure 2 shows a modified form of the system in which there are not only two control units but also two water tanks. Tank 40 and control unit 44 are positioned at one end of the fuselage while the second tank 40-II and the second control unit 44-II are positioned at the other end. Items in Figure 2 corresponding to items in Figure 1 are similarly referenced. As shown, each zone is arranged in substantially the same way as in Figure 1 in that it incorporates a manifold 18 and spray nozzles 22 to 30. Each manifold 18 in Figure 2, however, is connected to both tanks. Thus, for zone 10A the manifold 18A is connected by pipe 20A to tank 40 (via valve 42A) and is also connected to tank 40-II via pipe 20a and valve 42a. Similarly, each spray nozzle is not only controlled by control unit 44 (for example, via line 33A for zone 10A)

but is also controlled by control unit 44-II via a second control line (33a in the case of zone 10A). In addition to the temperature sensors 46,48, duplicate temperature sensors 46-II and 48-II are provided and are connected to the second control unit 44-II. Control unit 44-II responds to the temperature-dependent signals received on lines 50-II and 52-II (in the same way as does control unit 44 to the signals received on lines 50 and 52) and controls the valves 42a to 42e in the same way as control unit 44 controls values 42A to 42E.

In this way, therefore, each zone can not only be controlled from each end of the aircraft but can also be supplied with water from each end of the aircraft. In the event of break-up of the aircraft fuselage, the manifold 18 of each zone, and at least one of the temperature sensors, should remain connected to the water tank and control unit at at least one end of the aircraft.

Although the description above has referred to the protection of aircraft passenger cabins, systems embodying the invention may be used for other applications not necessarily restricted to aircraft and for protecting other parts of aircraft and non-passenger aircraft.

CLAIMS

1. A system for preventing or extinguishing fires in the cabin of an aircraft, comprising a plurality of water spray arrangements positioned within respective longitudinally spaced zones of the cabin, a water supply tank for all the water spray arrangements, connection means for separately connecting each water spray arrangement to the tank, a fire sensing arrangement for sensing for fire risk in each zone, and control means responsive to the fire sensing arrangement to cause water from the tank to be discharged by the water spray arrangement of any particular zone when the fire sensing arrangement detects a fire-critical condition therein.

2. A system according to claim 1, in which each water spray arrangement comprises at least one normally closed but controllably openable water spray nozzle, and in which each connection means comprises respective pipe means between the nozzle and the tank, the pipe means being normally empty of water, and in which the control means is responsive to the fire sensing arrangement to prime the pipe means of any particular zone with water when the fire sensing arrangement detects a warning condition in that zone indicative of an approaching fire-critical condition.

3. A system according to claim 2, in which the tank is connected to all of the pipe means through respective normally closed valve means, in which the fire-sensing arrangement comprises a temperature sensing arrangement, and in which the control means comprises means for opening the valve means of a particular one of the pipe means when the temperature sensing arrangement detects a temperature corresponding to the said warning condition in the zone corresponding to that pipe means and means for opening the or each nozzle of that zone when the temperature sensing arrangement detects a temperature in that zone corresponding to the said fire-critical condition.

4. A system according to any preceding claim, in which the fire sensing arrangement comprises a linear temperature sensor extending through the zones and associated control means responsive to the output of the sensor for detecting elevated temperature and for identifying the zone in which it exists.

5. A system according to claim 4, including at least two linear temperature sensors one connected to associated control means physically positioned near one end of the aircraft and the other connected to further associated control means physically positioned near the other end of the aircraft.

6. A system according to any preceding claim, in which the fire sensing arrangement comprises two separate temperature sensors, one attached to the inside of the fuselage of the aircraft and the other to the ceiling of the cabin.

7. A system according to any preceding claim, including a second water supply tank for all the water spray arrangements and physically spaced from the first-mentioned tank along the length of the aircraft, connection means for separately connecting each water spray arrangement to the second tank, and further control means responsive to the fire sensing arrangement to cause water from the second tank to be discharged by the water spray arrangement of any particular zone when the fire sensing arrangement detects a fire-critical condition therein.

8. A system for preventing or extinguishing fires in aircraft cabins, comprising water spray means mounted within the cabin along its length and controllably openable, at least one water supply tank, pipe means connecting the tank to the water spray means and normally empty of water, fire sensing means for detecting a fire-critical condition and for causing opening of the water spray means to permit discharge of water

therethrough from the water tank, and control means operative in response to detection of a warning condition indicative of an approaching fire-critical condition to prime the pipe means with water from the supply tank prior to occurrence of the fire-critical situation.

9. A system according to claim 8, in which the fire sensing means comprises temperature sensing means, and in which the control means comprises means responsive to detection of a first elevated temperature indicative of the warning condition, the fire-critical condition corresponding to detection of a second and higher temperature.

10. A system for preventing or extinguishing fires in aircraft cabins, comprising water spray means positioned along the length of the aircraft cabin, at least one water supply tank, connection means controllably connecting the water supply tank to the water spray means, and fire sensing means positioned within the cabin and operative in response to detection of a fire-critical condition to cause water to be supplied to the water spray means from the tank by the connection means and to be discharged into the cabin by the water spray means, the fire sensing means comprising a first fire detector within the cabin and attached to the ceiling of the cabin, and a second fire

detector attached essentially directly to the fuselage of the aircraft so as to be substantially unaffected by collapse of the ceiling in the event of an aircraft crash.

11. A water spray system for preventing or extinguishing fires in aircraft cabins, substantially as described with reference to Figure 1 of the accompanying drawings.

12. A water spray system for preventing or extinguishing fires in aircraft cabins, substantially as described with reference to Figure 2 of the accompanying drawings.

Paten' Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

- 17 -

Application number
GB 9304859.3

Relevant Technical fields
(i) UK Cl (Edition L) A5A (A20X5; A5)

(ii) Int Cl (Edition 5) A62C

Search Examiner
DR D ELSY

Databases (see over)
(i) UK Patent Office

(ii) ONLINE DATABASE: WPI

Date of Search
28 JUNE 1993

Documents considered relevant following a search in respect of claims 1-12

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	WO 91/07208 A (KIDDE-GRAVINER) See page 4 line 17 - page 5 line 1, and page 9 line 1 - page 10 line 15	1,7

Category	Identity of document and relevant passages	Relevant claim(s)
	-18-	

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

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P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

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